Estimation of the Variance Using Bootstrap Weights
User's Guide for the BOOTVARE_V30.SAS Program
(VERSION 3.0)

1. Introduction

This guide is for users of the SAS program BOOTVARE_V30.SAS which was created to estimate the variance using the bootstrap method.

Section 2 of this guide briefly explains the bootstrap resampling method used to estimate the variance. Section 3 gives detailed instructions for using the BOOTVARE_V30.SAS program, as well as a description of the preliminary steps that are required. The programs are given in Appendix A. Appendix B contains a complete example (programs and results). Finally, the survey-specific parameters required for executing the programs (file names, identification variables, etc.) are provided in the document "AppendixC_*XYZ*", where *XYZ* identifies the survey.

Changes from the Previous Version:

The biggest change made to the program is that a single version of the program supports all the Statistics Canada surveys that use the BOOTVAR program. Users only need to specify a few parameters (see the document AppendixC_*XYZ*) in section 1 of the program.

Please note that the program was tested and works with SAS versions 6.12 and 8.2.

2. Bootstrap Method

The sampling designs for Statistics Canada's surveys are generally complex. Since the variance for such designs cannot be estimated with simple formulas, resampling methods are often used to estimate the variance.

The bootstrap method consists of subsampling the initial sample. Within each stratum, a simple random sample (SRS) is selected, with replacement, from n-1 clusters within the n clusters of the stratum. The process is repeated 'B' times, creating B new samples (or replicates). Weights are recalculated for each of the B samples – the B weights are called the bootstrap weights. The bootstrap weights are used to calculate B estimates which are then used to estimate the variance.

The bootstrap weights have already been generated, and are available with the data. The BOOTVARE_V30.SAS program uses these bootstrap weights to estimate the variance for simple statistics such as totals and ratios, as well as for more complex analyses like regressions. These estimates of the variance should be used to derive quality indicators and to apply the survey's rules for releasing the estimates.

Here are the main steps for estimating the variance of a particular estimate using the bootstrap method:

A) Calculate an estimate (total, ratio, etc.) using the final weight included in the data file. This estimate is the point estimate.

B) Calculate the same estimate, this time using each of the B bootstrap weights contained in the bootstrap file. B estimates (total, ratio, etc) are then obtained.

C) Finally, calculate the variance of the B estimates. This variance is the estimate of the variance of the point estimate calculated in A.

3. Variance Estimation with the BOOTVARE_V30.SAS Program

The BOOTVARE_V30.SAS program calculates estimates of the variance of totals, ratios, differences between ratios, and linear or logistic regression parameters.

Variance estimation is performed in ***two steps*** and involves the use of three SAS programs. The ***first step*** consists of creating a data file containing the variables required for the analysis (first program). The ***second step*** involves using BOOTVARE_V30.SAS (and MACROE_V30.SAS) to estimate the variances.

Step 1: Creation of the Analysis File

The user needs to create a SAS data file which will be used as the input file for the program estimating the variance in step 2. The following tasks must be done in this step:

1. Reading of the input file
2. Creation of the variables required for the analysis

1 - Reading of the input file: The analysis file is created from the survey data file. The file layout must be provided in order to read in the variables contained in the file. See AppendixC_*XYZ* for the file and variable names.

2 - Creation of the variables required for the analysis: Variables derived from the input variables should be created in this step. It may be necessary to create dichotomous variables (1 or 0) which identify records that have a characteristic of interest – such variables will take a value of 1 for records that have the characteristic and a value of 0 otherwise. The total of a dichotomous variable will sum the weights of the records with the characteristic. See the example in Appendix B for more details.

The analysis file must contain:

- The necessary variables for the analysis (derived variables including dichotomous variables, and input variables that do not need to be modified). To reduce the runtime of the program, DO NOT keep unnecessary variables.
- The identification variable(s) of the respondents.
- If needed, the breakdown variable(s), identifying the groups for which a separate analysis is desired (ex.: province, sex, etc...).

- If the analysis is only of interest for a certain subgroup (for example, a province or an age group), keep only the records that are part of this subgroup.

REMARKS:

- It is recommended that point estimates be calculated at this step to be sure that the desired estimate is being calculated correctly, and that the program BOOTVARE_V30.SAS correctly calculates the same estimate. In this case, it is necessary to keep the weight variable when creating the analysis file.

- Means are estimated using the ratio macro in Step 2. Dichotomous variables identifying the records that are part of the group of interest must be created for the denominator.

The users must create their own program to prepare the analysis file containing the necessary variables for the analysis. An example of a program that creates this file is included in Appendix A (the program STEP1.SAS).

Step 2: Variance Calculation Using the BOOTVARE_V30.SAS Program

Once the new SAS data file is created in step 1, the next step consists of running the BOOTVARE_V30.SAS program. Before running it, the desired parameters and analyses must be specified. This program calls the MACROE_V30.SAS program.

MACROE_V30.SAS contains the program code of the various macros. *For standard use of the variance estimation program, no modification of the MACROE_V30.SAS program by the user is necessary*. Changes may be required in certain cases, as explained later.

The BOOTVARE_V30.SAS program is included in Appendix A. The parts that are to be changed by the user are given in ***bold type.*** The rest of the program does not need to be changed. The program is divided into ***two sections***. The ***first section*** is for specifying the required parameters, and the ***second section*** is for listing the desired analyses.

Section 1:

In this section, the user must specify:

- The name of the directory of the analysis file created in step 1 and of the output file containing the results
- The name of the data file (analysis file created in step 1)
- The name and directory of the bootstrap weights file
- The breakdown variable(s) to specify that the analysis is to be performed separately for specific sub-groups (ex.: provinces, sex)
- The identification variable(s) of the respondents, the weight variables and the number of bootstrap weights
- The name of the directory where the program MACROE_V30.SAS is located

N.B. AppendixC_*XYZ* contains survey-specific information (file names, certain variable names, number of bootstrap weights).

Section 2:

In this section, the user lists the analyses for which estimates of the variance are desired. The following types of analyses are supported:

- Totals
- Ratios (including means)
- Differences between ratios
- Regression models (linear or logistic)

For means: To estimate the variance of a mean, the macro for ratios can be used. The numerator is the variable of interest and the denominator is a dichotomious variable that identifies the population of interest.

For totals, ratios and differences between ratios: The variable of interest must be positive or null.

For differences between ratios: To calculate the difference between ratios, it may be necessary for the user to modify the macro *diff_rat* in the MACROE_V30.SAS program to suit their needs. See the notes included in the BOOTVARE_V30.SAS program for more details.

For regressions: Categorical variables will be treated as continuous variables. Dichotomous variables must be created in step 1 for each possible value (except one) of the categorical variable in order to treat this variable properly.

Modification to the program for testing purposes: Running the program could take long, especially for complex model analyses. It is possible to reduce the number of bootstrap weights used in order to test the program. **(However, to obtain the final estimates of the variance, it is important to use all of the bootstrap weights provided.)** To test the program, all that is required is to modify the parameter that specifies the number of bootstrap weights in the first part of the BOOTVARE_V30.SAS program.

Results Obtained with BOOTVARE_V30.SAS

The following results are obtained after running BOOTVARE_V30.SAS for totals, ratios and differences between ratios. See Appendix B for an interpretation of the results:

TYPE:	Type of estimate (total, ratio,diff_ratio)
VAR1 to VAR4:	Variables used to calculate the estimates.
n, n1, n3:	Tailles d'échantillons pour les totaux (n) et les ratios (n1 et n3)
YHAT:	Parameter estimate
BS_SD:	Standard deviation
BS_CV:	Coefficient of variation
CIL95:	Lower limit of the 95% confidence interval
CIU95:	Upper limit of the 95% confidence interval

The following results are obtained after running BOOTVARE_V30.SAS for linear and logistic regressions. See Appendix B for an interpretation of the results:

PARAM:	Parameter to estimate
BETA:	Parameter estimate
ODDS:	Odds ratio (logistic regression only)
WALD:	Wald statistic (logistic regression only)
PVALUE:	P-value of the Wald statistic (logistic regression only)
BSVAR:	Variance of the parameter estimate
BS_SD:	Standard deviation of the parameter
BS_CV:	Coefficient of variation for the parameter estimate
CIL95:	Lower limit of the 95% confidence interval (for the odds ratio if logistic regression)
CIU95:	Upper limit of the 95% confidence interval (for the odds ratio if logistic regression)

Appendix A contains the BOOTVARE_V30.SAS program, preceded by an example of a program which prepares the analysis file (STEP1.SAS). Appendix B contains a complete example (programs and results). Finally, AppendixC_*XYZ* contains survey-specific information (file names, names of certain variables, number of bootstrap weights).

APPENDIX A - Programs to Run

STEP 1.SAS Program

(Used as an example; the users can use their own program)

The parts in ***bold*** need to be changed.

```
*********************************************************
*                   STEP1.SAS                           *
*                                                       *
*        This program creates the SAS datafile          *
*        containing the necessary variables             *
*        for the BOOTVARE_V30.SAS program               *
*********************************************************;

LIBNAME in1 'directory_to_save_file_in';

*** Creation of the SAS data file containing the variables and cases required for the analysis. Note
*** that this file should be as small as possible (containing only necessary variables and cases) in
*** order to reduce time and memory requirements especially if regression type analysis are to be done.  ;

data in1.Name_of_analysis_file;          /* file to be used with BOOTVARE_V30.SAS */
    %let datafid= " name_and_location_of_source_file ";
    %include " name_and_location_of_layout ";

***  Creation of Dichotomous Variables                          ***
*** (examples are presented below using NPHS cycle 3 variables) ***;

   /* diabetes */
         if ccc8_1j=1 then diab=1;
         else diab=0;

   /* sex */
         if dhc8_sex=1 then males=1;
         else males=0;
         if dhc8_sex=2 then females=1;
         else females=0;

   /* diabetes*sex */
         mdiab = diab * males;      /* male diabetics   */
         fdiab = diab * females;    /* female diabetics */


   keep list of variables to keep;

         * It is recommended that only the necessary variables be kept    *
         * in order to reduce the runtime of BOOTVARE_V30.SAS.             *
         * IMPORTANT:  the identification variables and, if necessary,     *
         * the breakdown variable (ex: province, sex) must be kept. The    *
         * weight variable also must be kept if point estimates are        *
         * calculated at this step                                         *;

run;


****************************************
* Calculation of point estimates       *
* Suggested, but not required...       *
****************************************;

proc freq data=in1.Name_of_analysis_file;
     table variables of interest;
     weight weight_variable;
run;

proc logistic data=in1.Name_of_analysis_file ;
     model dependent_variable = independent variables ;
     weight weight_variable;
run;
```

BOOTVARE_V30.SAS Program

The parts in ***bold*** need to be changed.

```
...
...
...

/*************************************************************************/
/***                              SECTION 1                            ***/
/*************************************************************************/
/***                                                                   ***/
/***   This section lets the user specify the different parameters of  ***/
/***   interest (variable names, directory names, file names, etc.)    ***/
/***                                                                   ***/
/*************************************************************************/

*************************************************************************
** SPECIFY THE NAME OF THE FOLLOWING 2 DIRECTORIES (directories only): **
*************************************************************************;

      libname in1 "name_of_the_directory_containing_analysis_file_(step 1)";   /* (ex: c:\data) */
      libname out "name_of_the_directory_to_save_results_in";                  /* (ex: c:\output)*/

*************************************************************************
** SPECIFY THE NAME OF THE ANALYSIS FILE (CREATED IN STEP 1) (without extension):  **
*************************************************************************;

      %let Mfile = in1.Name_of_analysis_file;

*************************************************************************
** SPECIFY THE NAME OF THE FILE CONTAINING THE BOOTSTRAP WEIGHTS:      **
**        NB: Only run one of the two following series of commands     **
**        (comment the other one out, or erase it):                    **
*************************************************************************;

    *  EXECUTE THIS PART IF THE BOOTSTRAP WEIGHTS ARE IN SAS FORMAT (remove the " * ")
       ------------------------------------------------------------------------------;

        *            libname in2 "directory_name_containing_bootstrap_weights_file"; /* (ex: c:\bootstrp)*/
        *            %let bsamp=in2.SAS_file_name_containing_the_weights_(without extension) ;

    *  EXECUTE THIS PART IF THE BOOTSTRAP WEIGHTS ARE IN ASCII (.TXT) FORMAT (remove the " * ")
       ---------------------------------------------------------------------------------------;

        *            data bootwt;
        *              %let datafid="(directory)location_and_bootstrap_weights_file_(with_extension) ";
        *              %include "(directory)location_and_file_name_of_layout_(with_extension)";
        *            run;
        *            %let bsamp=bootwt;

*************************************************************************************************
** SPECIFY, IF DESIRED, THE BREAKDOWN VARIABLE(S) (EG: PROVINCE, SEX, ETC...):                  **
**     Write the name of the breakdown variable(s) below.                                       **
**                                                                                              **
**     -  If the analysis includes all of the data in the file created in step 1, put           **
**        a dot. (%let classes =. )                                                             **
**     -  If more than one variable, leave a blank between each variable                        **
**        (%let classes=var1 var2)                                                              **
**     -  DO NOT ERASE OR COMMENT OUT THIS COMMAND                                              **
*************************************************************************************************;

      %let classes = breakdown_variable(s)_or_a_dot;

*************************************************************************************************
** SPECIFY THE FOLLOWING INFORMATION (SPECIFIC TO THE SURVEY YOU ARE USING):                    **
**    You must specify:                                                                         **
**           1- The unique identifier variable(s) (separated by a space)                        **
**           2- The Final Weight (variable included in the bootstrap weight file)               **
**           3- The prefix of the boostraps weight variables                                    **
**           4- The number of bootstrap weights to use (note: For testing, B must be >= 2.     **
**              IT IS NECESSARY TO USE ALL THE BOOTSTRAP WEIGHTS WHEN PERFORMING THE FINAL      **
**              ANALYSIS.  THE COMPLETE BOOTVARE_V30.SAS PROGRAM MUST THEN BE RUN.)             **
**                                                                                              **
**           - Refer to AppendixC_XYZ  to obtain this information                               **
*************************************************************************************************;

      %let ident = unique identifier variable(s);
      %let fwgt  = final_weighf;
      %let bsw   = prefix_of_bootstrap_weight_variables;
      %let B     = number_of_weights_to_use ;

*************************************************************************
** SPECIFY THE DIRECTORY AND THE NAME OF THE FILE THAT CONTAINS THE MACROS     **
** (THE PROGRAM MACROE_V30.SAS IF NO MODIFICATIONS HAVE BEEN MADE BY THE USER) **
*************************************************************************;

      %include "directory_name_of_macroe_V30.sas\MACROE_V30.SAS";
```

```
/*************************************************************************/
/***                              SECTION 2                            ***/
/*************************************************************************/
/***                                                                   ***/
/*** This section lets the user specify the different analyses of interest.***/
/***                                                                   ***/
/*************************************************************************/

...
...
...

* TO OBTAIN VARIANCE ESTIMATES OF A TOTAL, RUN:
  ------------------------------------------;

       *  %total(variable_name);

* TO OBTAIN VARIANCE ESTIMATES OF A RATIO, RUN:
  ------------------------------------------;

       *  %ratio (numerator_variable, denominator_variable);

* TO OBTAIN VARIANCE ESTIMATES OF A DIFFERENCE BETWEEN RATIOS, RUN:
  ---------------------------------------------------------------;
                  *NOTE: see the comment at the beginning of section 2 ... ;

       *  %diff_rat(VAR1,VAR2,VAR3,VAR4);

                        *  where:  var1   : the numerator variable of the first ratio     *
                        *          var2   : the denominator variable of the first ratio   *
                        *          var3   : the numerator variable of the second ratio    *
                        *          var4   : the denominator variable of the second ratio  *;

* TO OBTAIN VARIANCE ESTIMATES OF REGRESSION PARAMETERS, RUN:
  ---------------------------------------------------------;

      *   %regress(dependent_variable, independent_variables_(no comma)) ;

* TO OBTAIN VARIANCE ESTIMATES OF LOGISTIC REGRESSION PARAMETERS, RUN:
  ------------------------------------------------------------------;

      *   %logreg(dependent_variable, independent_variables_(no comma));


%output;  /*Displays the results on the screen.  Do not modify. */

* TO SAVE THE RESULTS IN A FILE, RUN: (remove the "*")
  --------------------------------------------------;

      *  data out.Results_filename ;
      *    set &result ;
      *  run;

/* end of BOOTVARE_V30.SAS program  */
```

APPENDIX B

This is a complete example showing how to use the program BOOTVARE_V30.SAS. First, the analysis data file is created (step 1). Then, BOOTVARE_V30.SAS is adapted to obtain the desired analysis. The results that are produced follow the programs.

Example:

This example uses the cycle 3 (1998) cross-sectional file of the National Population Health Survey, general component. This example:

1- Computes the total number and the proportion of diabetics in the population and for the men, for each province (only four provinces will be kept).

2- Studies the relationship between diabetes, sex and type of interview (proxy or not), for each province.

The different parameters needed in the program (specified in AppendixC_Health) are:

NPHS - Household Component							
	Name of data file	**Name of bootstrap weights file** *(ASCII format: .txt SAS format: .sd2 or .sas7bdat)*	**Identification variables**	**Weight variable** *(on the data file)*	**Weight variable** *(on the bootstrap weights file)*	**Prefixe of the bootstrap weights**	**# of weights**
Cycle 3	H35.txt	B5H35	REALUKEY PERSONID	WT58 (M) WT58_S (S)	FWGT	BSW	500

Step 1:

```
*********************************************************
*                   STEP1.SAS                           *
*                                                       *
*        This program creates the SAS datafile          *
*        containing the necessary variables             *
*        for the BOOTVARE_V30.SAS program               *
*********************************************************;


LIBNAME in1 'C:\BOOTVAR\';


*** Creation of the SAS data file containing the variables and cases required for the analysis. Note
*** that this file should be as small as possible (containing only necessary variables and cases) in
*** order to reduce time and memory requirements especially if regression type analysis are to be done. ;



data in1.diabetes;                /* file to be used with BOOTVARE_V30.SAS */
   %let datafid='D:\Data\h35.txt';
   %include 'D:\Layout\h35_i.sas';


***  keep only 4 provinces;
             if prc8_cur in (10 24 35 59);



***  Creation of Dichotomous Variables                          ***
*** (examples are presented below using NPHS cycle 3 variables) ***;

   /* diabetes */
          if ccc8_1j=1 then diab=1;
          else diab=0;


 /* Dichotomous variable (0/1) for type of interview  */

          nonproxy=0;
          if am58_pxy>2 then nonproxy=.;
          if am58_pxy=2 then nonproxy=1;

  /* sex */
          total=1;
          if dhc8_sex=1 then males=1;
          else males=0;
          if dhc8_sex=2 then females=1;
          else females=0;

   /* diabetes*sex */
          mdiab = diab * males;      /* male diabetics   */
          fdiab = diab * females;    /* female diabetics */



     keep diab total males females mdiab fdiab nonproxy wt58 realukey personid prc8_cur;

          * It is recommended that only the necessary variables be kept    *
          * in order to reduce the runtime of BOOTVARE_V30.SAS.             *
          * IMPORTANT:  the identification variables and, if necessary,     *
          * the breakdown variable (ex: province, sex) must be kept. The    *
          * weight variable also must be kept if point estimates are        *
          * calculated at this step                                         *;

run;


****************************************
* Calculation of point estimates       *
* Suggested, but not required...       *
****************************************;

PROC SORT DATA=in1.diabetes; BY prc8_cur; RUN;

proc freq data=in1.diabetes;
     table diab mdiab fdiab;
          by prc8_cur;
     weight wt58;
run;

proc logistic data=in1.diabetes;
     model diab = nonproxy  females;
          by prc8_cur;
     weight wt58;
     TITLE "Relationship between diabetes, sex and type of interview";
run;
```

Step 2 - BOOTVARE_V30.SAS program:

```
...
...
...

/*************************************************************************/
/***                            SECTION 1                              ***/
/*************************************************************************/
/***                                                                   ***/
/***   This section lets the user specify the different parameters of  ***/
/***   interest (variable names, directory names, file names, etc.)    ***/
/***                                                                   ***/
/*************************************************************************/


*************************************************************************
** SPECIFY THE NAME OF THE FOLLOWING 2 DIRECTORIES (directories only): **
*************************************************************************;

      libname in1 "C:\BOOTVAR";                /* (ex: c:\data) */
      libname out "C:\BOOTVAR";                /* (ex: c:\output)*/


*****************************************************************************
** SPECIFY THE NAME OF THE ANALYSIS FILE (CREATED IN STEP 1) (without extension):  **
*****************************************************************************;

      %let Mfile = in1.diabetes;


*************************************************************************
** SPECIFY THE NAME OF THE FILE CONTAINING THE BOOTSTRAP WEIGHTS:      **
**        NB: Only run one of the two following series of commands     **
**        (comment the other one out, or erase it):                    **
*************************************************************************;

    *  EXECUTE THIS PART IF THE BOOTSTRAP WEIGHTS ARE IN SAS FORMAT (remove the " * ")
       ------------------------------------------------------------------------------;

                libname in2 "D:\bootstrp\DATA";
                %let bsamp = in2.b5h35;

    *  EXECUTE THIS PART IF THE BOOTSTRAP WEIGHTS ARE IN ASCII (.TXT) FORMAT (remove the " * ")
       ---------------------------------------------------------------------------------------;

  *                 data bootwt;
  *                   %let datafid="(directory)location_and_bootstrap_weights_file_(with_extension) ";
  *                   %include "(directory)location_and_file_name_of_layout_(with_extension)";
  *                 run;
  *                 %let bsamp=bootwt;


*****************************************************************************************
** SPECIFY, IF DESIRED, THE BREAKDOWN VARIABLE(S) (EG: PROVINCE, SEX, ETC...):          **
**     Write the name of the breakdown variable(s) below.                                **
**                                                                                       **
**     -  If the analysis includes all of the data in the file created in step 1, put    **
**        a dot. (%let classes =. )                                                      **
**     -  If more than one variable, leave a blank between each variable                 **
**        (%let classes=var1 var2)                                                       **
**     -  DO NOT ERASE OR COMMENT OUT THIS COMMAND                                       **
*****************************************************************************************;

      %let classes = prc8_cur;

*****************************************************************************************
** SPECIFY THE FOLLOWING INFORMATION (SPECIFIC TO THE SURVEY YOU ARE USING):            **
**    You must specify:                                                                  **
**          1- The unique identifier variable(s) (separated by a space)                 **
**          2- The Final Weight (variable included in the bootstrap weight file)        **
**          3- The prefix of the boostraps weight variables                             **
**          4- The number of bootstrap weights to use (note: For testing, B must be >= 2. **
**             IT IS NECESSARY TO USE ALL THE BOOTSTRAP WEIGHTS WHEN PERFORMING THE FINAL **
**             ANALYSIS.  THE COMPLETE BOOTVARE_V30.SAS PROGRAM MUST THEN BE RUN.)       **
**                                                                                       **
**          - Refer to AppendixC_XYZ  to obtain this information                         **
*****************************************************************************************;

      %let ident = realukey personid;
      %let fwgt  = fwgt;
      %let bsw   = bsw;
      %let B     = 500 ;

*****************************************************************************
** SPECIFY THE DIRECTORY AND THE NAME OF THE FILE THAT CONTAINS THE MACROS     **
** (THE PROGRAM MACROE_V30.SAS IF NO MODIFICATIONS HAVE BEEN MADE BY THE USER) **
*****************************************************************************;

      %include "C:\BOOTVAR\MACROE_V30.SAS";
```

```
/*****************************************************************************/
/***                              SECTION 2                                ***/
/*****************************************************************************/
/***                                                                       ***/
/*** This section lets the user specify the different analyses of interest.***/
/***                                                                       ***/
/*****************************************************************************/

...
...
...

* TO OBTAIN VARIANCE ESTIMATES OF A TOTAL, RUN:
  ------------------------------------------;

        *  %total(variable_name);

    %total(diab);
    %total(mdiab);


* TO OBTAIN VARIANCE ESTIMATES OF A RATIO, RUN:
  ------------------------------------------;

        *  %ratio (numerator_variable, denominator_variable);

    %ratio(diab,total);
    %ratio(mdiab,males);


* TO OBTAIN VARIANCE ESTIMATES OF A DIFFERENCE BETWEEN RATIOS, RUN:
  ---------------------------------------------------------------;
                   *NOTE: see the comment at the beginning of section 2 ... ;

        *  %diff_rat(VAR1,VAR2,VAR3,VAR4);

                         *  where:  var1   : the numerator variable of the first ratio     *
                         *          var2   : the denominator variable of the first ratio   *
                         *          var3   : the numerator variable of the second ratio    *
                         *          var4   : the denominator variable of the second ratio  *;


* TO OBTAIN VARIANCE ESTIMATES OF REGRESSION PARAMETERS, RUN:
  ---------------------------------------------------------;

       *   %regress(dependent_variable, independent_variables_(no comma)) ;


* TO OBTAIN VARIANCE ESTIMATES OF LOGISTIC REGRESSION PARAMETERS, RUN:
  ------------------------------------------------------------------;

       *   %logreg(dependent_variable, independent_variables_(no comma));
     %logreg(diab,nonproxy females);


%output;  /*Displays the results on the screen.  Do not modify. */


* TO SAVE THE RESULTS IN A FILE, RUN: (remove the "*")
  --------------------------------------------------;

        data out.results ;
          set &result ;
        run;


/* end of BOOTVARE_V30.SAS program  */
```

Results and interpretation:

The tables on the next page present the results of the analyses done using the programs from the example. Results for the totals and ratios are presented in the first and second tables.

For totals and ratios, the first lines in the output give the results for the entire file (ALL). Results for each category of the breakdown variable(s) follow. For example, if we want the ratio of the number of diabetic males to the total number of males, in Ontario, we look at observation 8 in the second table. The region 35 corresponds to the province of Ontario (see the data dictionary document included on the CD-ROM for the codes associated with each province) and the variable Type indicates the type of analysis, in this case a ratio. We find the variables *mdiab* (VAR1) as the numerator of the ratio and *males* (VAR2) as the denominator. The column n1 indicates that the data file contains 190 diabetics males in Ontario (sample size for the numerator). The estimate of the ratio is 3.57% (YHAT) with a standard deviation of 0.29 (BS_SD) and a coefficient of variation of 8.00% (BS_CV). The 95% confidence interval for this estimate is (3.01%, 4.14%) (CIL95, CIU95).

Results from the logistic regression are shown in the third table. For example, the estimate of the parameter for the variable *females* in Ontario (observation 9) is -0.34507 (BHAT) and the odds ratio is 0.70817 (ODDS). The Wald's statistic for this parameter and its associated p-value are 14.28 (WALD) and p=0.00016 (PVALUE) respectively. The estimates of the variance and the standard deviation for the parameter estimate are 0.00834 (BS_VAR) and 0.09132 (BS_SD) and the coefficient of variation is 26.47% (BS_CV). Finally, the confidence interval for the odds ratio is (0.52918%, 0.88717%) (CIL95,CIU95).

Variance Estimation for a Total
(using 500 bootstrap replicates)

Obs	prc8_cur	type	var	n	Estimate	bs_sd	bs_cv	CIL95	CIU95
1	All	Total	diab	785	698848.46	27250.05	3.90	645438.37	752258.55
2	All	Total	hdiab	392	378528.18	20925.33	5.53	337514.54	419541.83
3	10	Total	diab	99	20741.31	1845.88	8.90	17123.38	24359.23
4	10	Total	hdiab	35	7029.11	1380.61	19.64	4323.11	9735.10
5	24	Total	diab	199	205292.21	15960.30	7.77	174010.03	236574.40
6	24	Total	hdiab	104	110452.77	10944.25	9.91	89002.04	131903.51
7	35	Total	diab	374	362439.56	19721.07	5.44	323786.27	401092.86
8	35	Total	hdiab	190	198237.67	15854.33	8.00	167163.17	229312.16
9	59	Total	diab	113	110375.38	10847.03	9.83	89115.19	131635.56
10	59	Total	hdiab	63	62808.64	8568.12	13.64	46015.12	79602.15

Variance Estimation for a Ratio
(using 500 bootstrap replicates)

Obs	prc8_cur	type	var1	var2	n1	Estimate	bs_sd	bs_cv	CIL95	CIU95
1	All	Ratio	diab	total	785	0.0306	0.0012	3.90	0.0282	0.0329
2	All	Ratio	hdiab	males	392	0.0335	0.0019	5.53	0.0299	0.0371
3	10	Ratio	diab	total	99	0.0385	0.0034	8.90	0.0318	0.0453
4	10	Ratio	hdiab	males	35	0.0263	0.0052	19.64	0.0162	0.0365
5	24	Ratio	diab	total	199	0.0287	0.0022	7.77	0.0243	0.0331
6	24	Ratio	hdiab	males	104	0.0312	0.0031	9.91	0.0252	0.0373
7	35	Ratio	diab	total	374	0.0322	0.0018	5.44	0.0288	0.0356
8	35	Ratio	hdiab	males	190	0.0357	0.0029	8.00	0.0301	0.0413
9	59	Ratio	diab	total	113	0.0283	0.0028	9.83	0.0228	0.0337
10	59	Ratio	hdiab	males	63	0.0324	0.0044	13.64	0.0237	0.0411

Variance Estimation for a Logistic Regression
Dependent variable: diab
(using 500 bootstrap replicates)

Obs	PRC8_CUR	param	beta	odds	wald	pvalue	bs_var	bs_sd	bs_cv	CIL95	CIU95
1	10	Intercept	-4.00372	0.01825	831205.16	0.00000	0.00002	0.00439	0.11	0.00964	0.02685
2	10	nonproxy	0.85783	2.35803	2.09	0.14824	0.35204	0.59333	69.17	1.19511	3.52096
3	10	females	0.46625	1.59401	0.87	0.35123	0.25016	0.50016	107.27	0.61370	2.57432
4	24	Intercept	-3.89892	0.02026	2226070.39	0.00000	0.00001	0.00261	0.07	0.01514	0.02539
5	24	nonproxy	0.89121	2.43807	4.94	0.02618	0.16065	0.40082	44.97	1.65247	3.22367
6	24	females	-0.36991	0.69080	10.75	0.00104	0.01273	0.11283	30.50	0.46965	0.91194
7	35	Intercept	-3.57575	0.02799	1325488.73	0.00000	0.00001	0.00311	0.09	0.02191	0.03408
8	35	nonproxy	0.60946	1.83943	6.35	0.01171	0.05845	0.24177	39.67	1.36557	2.31329
9	35	females	-0.34507	0.70817	14.28	0.00016	0.00834	0.09132	26.47	0.52918	0.88717
10	59	Intercept	-3.99955	0.01832	971323.00	0.00000	0.00002	0.00406	0.10	0.01037	0.02628
11	59	nonproxy	1.05756	2.87934	1.67	0.19693	0.67172	0.81959	77.50	1.27295	4.48574
12	59	females	-0.46337	0.62916	10.16	0.00143	0.02113	0.14535	31.37	0.34428	0.91404